Biological Observations with *Zeteticontus* sp. (Hymenoptera: Encyrtidae) A Parasite of *Carpophilus hemipterus* (L.) (Coleoptera: Nitidulidae)

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INTRODUCTION

Carpophilus hemipterus (L.) is a widespread nitidulid beetle, which together with a few allied species, occurs on decaying vegetation and fruit. This species may also be destructive to dried fruits and cereals in storage (Essig 1942). In Hawaii, these beetles breed in large numbers in knocked-down pineapple fields where they feed upon the rotting stems. Once their food source has been exhausted, the beetles migrate to other places looking for new food sources. Large swarms of migrating beetles arrive in human habitations and cause a nuisance problem. A search for natural enemies of these pests has been undertaken, and the senior author was contacted and asked to obtain parasites of souring beetles from Israel to ship to Hawaii. This paper deals with some biological observations made during the project.

MATERIALS AND METHODS

We searched for *Zeteticontus* in the breeding places of its host, *C. hemipterus*. For this purpose, damaged and decaying fruit of apple, avocado, citrus, cotton (damaged green balls), date, fig, grape, melons, pear, pomegranate and tomato were collected off the ground, with some earth underneath them, and placed for emergence in the lab. This was done at least once a month, and covered most regions of Israel except for the Negev desert. We also placed plastic exposure containers in permanent locations, and tended them once a month. They measured about 40 x 20 x 20 cm, on their floor there was a layer of moist sand on which rotting seasonal fruits were placed. A 1-cm mesh screen was used to cover the box in order to prevent vertebrates from feeding on its contents. Every two weeks a new box with freshly cut fruits was put in the place of the old one. The fruit from the old box with the beetles that developed in them, was transferred to a new box, and the old box with the sand containing beetle larvae and pupae, was taken to the lab for rearing.

Laboratory rearing of *Carpophilus* was done by placing the fruits for oviposition in open plastic petri dishes, the bottoms of which have been perforated. The dishes were laid upon moist sand in a transparent plastic box of 15 x 15 x 15 cm with a tight lid that had an opening covered by a 100 mesh screen.

For rearing *Zeteticontus*, the hosts were placed as adults into the rearing box with apple slices, or with an artificial bran-base medium used for fruit fly rearing, (Rado, Roessler and Koltin, 1975). The apples had to be of solid consistency, or they became too watery for larval survival.

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About 1-1/2 weeks after the introduction of the beetles, the dish with the larval material and their food was removed into a new sand-bottomed rearing box. The sand from the original box was placed in water where the pupae were separated and kept on paper towels until adult emergence.

The parasite females were given apple slices on which small larvae of the hosts were exposed. These were stung readily. About 3-5 days after they have been oviposited in, the hosts' larvae left the food and entered the sand. A few days later they mumified and became brown. At that time, the feeding medium with the active larvae was transferred to new sand in another rearing box. The sand that covered the old box was placed in water, whereupon the mumified larvae floated and were thus collected. The rest of the material was placed upon fresh sand with which the separation process was repeated 5 days later. The adult parasites emerged about 1 week after the separation or 2-2 1/2 weeks from introduction to their hosts.

Results

Biology of the hosts:

Adults of *C. hemipterus* could usually be found in the field on or about fruits as mentioned. The natural abundance of such fruits sustained the beetle populations throughout the year. However, the developmental duration varied with temperature. In our rearing cabinets at 30°C, development lasted as follows: egg 2 days, larva 5-7 days, pupa 7 days.

The adult beetles lay their eggs on damaged, often fermenting parts of the host material, where their larvae developed at the expense of the fermenting tissues. Larvae remained on the surface of the food material and did not penetrate into liquid parts, probably being unable to breathe therein. Once the larvae matured, they dropped onto the drier ground under the food and pupated there. The emerging adults, being attracted to decaying material, oviposited at the same site in which they had developed, providing the host material was still suitable.

Biology of the parasites:

Zeteticontus sp. is a biparental arrhenotokous encyrtid. Mating occurs shorly after emergence. Oviposition by the females starts shortly thereafter, unmated females ovipositing also readily; however, all their progeny are males. Parasite females examine, and perform "stinging motions" on larvae of both *Urophorus humeralis* (F.) and *C. hemipterus* but progeny was recovered only from *C. hemipterus.* The process of stinging takes a few seconds and the host is not paralyzed, rather it wriggles violently. All larval instars were attacked by the parasite female, but only early and middle instars proved suitable.

Zeteticontus sp. is a solitary internal parasite. Its life cycle at 25-27°C is 14-18 days. Longevity of mated females reached 17 days, but unmated females lived twice as long at 25°C (50 days at 15°C).

There is slight proterandry in emergence and the normal sex ratio is about 1. However, when allowed to emerge within a small, closed container, the parasites often fail to mate resulting in a preponderance of male progeny in the next generation. To overcome this problem, which may be caused by the influence of crowding on pheromonal communication, we

introduced one male and one female each time into a test tube where they mated.

The Distribution of the Hosts and Parasites

C. hemipterus is present the year round; however, the parasites were recovered in the field only during the late summer and fall. At that time they were relatively easy to find since they, like their hosts, were attracted to rotting fruit. Our methodology permitted us to concentrate our efforts mainly in one geographic region, the coastal plain of Israel. Consequently, we don't have a full record of the parasites' distribution. However, judging from the availability of the hosts, and from the records of presence of parasites in the Jordan Valley and along the coast, we may assume that *Zeteticontus* sp. is probably distributed over all of Israel.

Because the hosts develop in decaying matter, the consistency and composition of which change quickly, they and their parasites are able to develop only a very few generations in the same micro-niche. Thereafter, they either move to an adjacent niche if such is available, or they must leave the area in search of new decaying plant material.

Discussion

Whereas the hosts are able to develop readily all of the seasons of Israel's Mediterranean climate, the parasites apparently require warm weather for successful activity. Therefore, they were found only during the late summer and fall.

The availability of hosts, coupled with the quality of the food medium, limit the parasites' capability to develop successfully, and dictates their developmental strategy. The parasites are attracted to sites that are suitable for host oviposition, in which eggs and young host larvae are apt to occur, in fruits which still have a firm consistency. This allows the female to find young, suitable hosts while walking on a solid substrate.

However, changes occurring in the physical state of the substrate make it unsuitable for host and parasite alike. In order to cope with this problem, the host insect has developed a suitable opportunistic or "r" strategy with great power of dispersal and speedy rate of development, that allow it to exploit the temporary habitats as long as they are suitable. Consequently, it never reaches a steady-state condition in which its populations would be in equilibrium with factors such as natural enemies, and other competing species.

The instability of the host populations poses difficulties in the utilization of parasites for biological control (Southwood and May 1970). The potential of *C. hemipterus* and other nitidulids to move into knocked-down pineapple fields in Hawaii and reach very high populations within few generations almost precludes their control by parasites *at that site.* However, a suitable parasite, that will be able to move from one host infestation site to the next, and reduce the *general host level* significantly may help to alleviate the problem.

ACKNOWLEDGEMENTS

We wish to thank the Hawaiian Department of Agriculture for having made this study possible, and to Dr. Z. Boucek of the British Museum of Natural History for having identified the parasite.

References Cited

Essig, E. O. 1942. College Entomology. The McMillian Co. New York. 900 pp.

Rado M. Y. Roessler, and Y. Koltin 1975. The chromosomes of the Mediterranean fruit fly, *Ceratitis capitata* (Wied): Karotype and chromosomal organization. Cytologia 40:823-828.

Southwood, T. R. E. and M. J. May 1970. Ecological background to pest management. Pages 6-28 *in* R. L. Rabb and E. L. Guthrie, eds. Concepts of pest management. North Carolina State University, Raleigh.